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14. ABSTRACT The occurrence of major depressive disorder (MDD) among military pilots and navigators poses questions with respect to medical care and waiver policy, but the prevalence of such disorders is unclear. We studied the epidemiology of MDD in a USAF aircrew population. The occurrence of MDD was determined for the period 2001-2006 using the USAF Aeromedical Information Management Waiver Tracking System, which records medical disqualifications and waivers for the entire population of both qualified and disqualified (grounded) USAF aviators. The mean annual population of USAF pilots and navigators averaged 17,781 during the study period. The database yielded 51 cases of MDD, of which 8 were recurrent and 43 were single episodes. All of the recurrent cases were disqualified, while 18 of the single-episode cases (42%) received a flying waiver after being asymptomatic without medications for at least 6 months. Estimated annual MDD prevalence was 0.06% for the study population. In comparison, the annual prevalence of MDD is 6.7% in the general U.S. population, 2.8% among groups of executives, and 4.1% among professionals. Odds ratios were 128 (68,238), 51 (27,96), and 76 (41,142) for the general population, executives, and professionals, respectively. Annual MDD prevalence among USAF pilots and navigators was significantly lower than that of the general U.S. population. The difference may reflect lower aircrew vulnerability to depression because of selection and training processes or lower rates of self-report and treatment due to feared aeromedical and/or career consequences.					
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Major Depressive Disorder in Military Aviators: A Retrospective Study of Prevalence

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Introduction: The occurrence of major depressive disorder (MDD) among military pilots and navigators poses questions with respect to medical care and waiver policy, but the prevalence of such disorders is unclear. We studied the epidemiology of MDD in a USAF aircrew population. **Methods:** The occurrence of MDD was determined for the period 2001-2006 using the USAF Aeromedical Information Management Waiver Tracking System, which records medical disqualifications and waivers for the entire population of both qualified and disqualified (grounded) USAF aviators. **Results:** The mean annual population of USAF pilots and navigators averaged 17,781 during the study period. The database yielded 51 cases of MDD, of which 8 were recurrent and 43 were single episodes. All of the recurrent cases were disqualified, while 18 of the single-episode cases (42%) received a flying waiver after being asymptomatic without medications for at least 6 mo. Estimated annual MDD prevalence was 0.06% for the study population. In comparison, the annual prevalence of MDD is 6.7% in the general U.S. population, 2.8% among groups of executives and 4.1% among professionals. Odds ratios were 128 (68,238), 51 (27,96), and 76 (41,142) for the general population, executives, and professionals, respectively. **Discussion:** Annual MDD prevalence among USAF pilots and navigators was significantly lower than that of the general U.S. population. The difference may reflect lower aircrew vulnerability to depression because of selection and training processes or lower rates of self-report and treatment due to feared aeromedical and/or career consequences. **Keywords:** military aviators, epidemiology, depression, waiver.

THE EPIDEMIOLOGIC impact of major depressive disorder (MDD) within the military aircrew population is unknown. A conservative annual prevalence for MDD in the U.S. general population is 6.7% (12). We analyzed a USAF electronic database, the Aeromedical Information Management Waiver Tracking System (AIMWTS) to explore and determine the epidemiology of MDD in a population of USAF pilots and navigators. Our aim was to provide epidemiological information for USAF aeromedical policy makers to facilitate improved pilot and navigator waiver decisions, policy determinations, and allocation of aeromedical resources.

Current USAF aeromedical policy states that any aircrew member diagnosed with MDD must be removed from flying status until such time as the individual has been appropriately treated and has been asymptomatic and without medications for at least 6 mo (22). Major depression is incompatible with flying duty as is the treatment with antidepressant medication because of potential medication side effects (2,21,22). Improvements

in antidepressant medication side-effect profiles and maturation of the standards for psychiatric management of MDD have led policy makers to consider changes in the aeromedical management of pilots and navigators diagnosed with MDD.

Within the general population, MDD is one of the more common mood disorders and was listed as number 6 of the 10 most concerning public health indicators by Healthy People 2010 (5). Symptoms of major depression include sadness or irritability, a decreased energy level, anhedonia, difficulty concentrating, feelings of guilt, helplessness, hopelessness, sleep problems such as insomnia or hypersomnia, decrease in libido, appetite changes, and suicidal ideation (8). To be diagnosed with major depression, one must experience the majority of these symptoms for at least 2 wk (1). The initial episode of major depression predisposes an individual to increased probability of having another such episode sometime in their life (18). Approximately 50% of individuals who experience a major depressive episode will have a recurrence within 5 yr. A history of two episodes increases the probability of recurrence to approximately 70%, and after three episodes the probability of recurrence increases to approximately 90% (1).

Consequences of major depression range from obviously severe to subtle incapacitation of higher cognitive functioning. Pilots/navigators are responsible for precise aircraft control and direction in unforgiving, demanding situations. Manifestations of depression such as difficulty concentrating, decreased energy, feelings of helplessness and/or hopelessness, sleep disturbance, or suicidal ideation profoundly affect flying safety and successful mission completion. Two-thirds of patients with major depression contemplate suicide and 10 to 15% actually do so (8). Within the pilot population, suicide by aircraft is quite rare and there is very little explicit

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data regarding suicide in general within this population (14). The burden of this disease is quite large, negatively impacting the Disability Adjusted Life Year of patients and, through suicide, the Years of Potential Life Lost. In 1999, the costs of major depression in the United States amounted to 63 billion dollars because of Disability Adjusted Life Year and 12 billion dollars because of Years of Potential Life Lost secondary to suicide (13). In 1990 the costs of major depression in the general population amounted to 43.7 billion dollars, including 12.4 billion dollars of direct medical treatment (4). Estimates of the cost to the Air Force are unavailable. Remarkably, two-thirds of people diagnosed with MDD do not seek appropriate care for their illness (3).

METHODS

The Air Force Research Laboratory Institutional Review Board, Wright-Patterson Air Force Base, OH, approved an "exempt" protocol which allowed retrospective exploration of the AIMWTS database from July 2001 through June 2006. The database was searched for MDD in USAF pilots and navigators by International Classification of Disease and Diagnostic and Statistical Manual codes as well as key words such as "depression." The search was refined to exclude unrelated diagnoses such as "ST Segment Depression" and "Open Angle Depression." The search was narrowed to flying class II pilots and navigators and excluded colonels, general officers, flight surgeons, and pilots and navigators of the Air Force Reserve and Air National Guard. Diagnoses were reviewed for accuracy by senior psychiatrists at the USAF's Aeromedical Consultation Service, Brooks City-Base, San Antonio, TX.

RESULTS

The search method cast a broad net across the 5-yr study period. Information and data regarding MDD, Dysthymia, Depressive Disorder Not Otherwise Specified, and Adjustment Disorder with Depressed Mood were discovered. These were all forms of depression with aeromedical impact and will, hopefully, be the subject of future epidemiological study. In this paper, we focused on MDD. There were 51 cases of MDD discovered, of which 8 were recurrent and 43 were single episode (Table I). Of the eight cases of recurrent depression, none (0%) received a waiver. Of the 43 single-episode cases, 18 (42%) received a waiver allowing them to fly after being asymptomatic and without medications for at least 6 mo.

The average annual number of pilots and navigators from fiscal year 2001 through fiscal year 2005 was 17,781 (data from USAF Military Personnel Center, Randolph AFB, TX). The number of MDD episodes (51 total) in the 5-yr period was divided by five to yield an estimated annual number of 10 episodes. The estimated annual prevalence of MDD over the 5-yr study was 10 cases out of 17,781 individuals or 0.056% (6/10,000).

The U.S. population annual prevalence of MDD was compared with the annual prevalence of MDD in the study population by Chi-square analysis. Categories for

TABLE I. DEPRESSIVE DISORDER DATA* IN USAF PILOTS AND NAVIGATORS.

Condition	Total	Pilots	Navigators	Received Waiver
MDD Recurrent	8	6	2	0
MDD Single Episode	43	30	13	18

* Data from AIMWTS: July 2001–June 2006.

the statistical hypotheses were as follows: diagnosed major depression vs. no diagnosis and USAF pilots and navigators vs. U.S. general population. The estimated percentage of USAF pilots and navigators with MDD was 0.056%. The estimated percentage of patients with MDD in the U.S. general population was 6.7%. A 2 × 2 categorical contingency table was established and run in Statistical Analysis Software (SAS). Analysis of two proportions conducted by Chi-square (16) yielded $P < 0.0001$. Therefore, there was a significant difference in the annual prevalence rate of MDD between USAF pilots and navigators and the U.S. general population. The USAF pilot or navigator had a low relative risk (odds) of having MDD when compared to the U.S. general population. The odds ratio (OR) was OR = 128(95% CI, 68 to 238) for a sample size of 35,562.

Estimated annual MDD prevalence rates were sought in populations with educational and occupational levels more closely related to the USAF pilot and navigator population than the general US population. The estimated annual prevalence of major depression in a job category including "executives, administrators, and managers" was 2.8% (19). Comparing this to the prevalence of MDD in USAF pilots and navigators yielded a Chi-square statistic with $P < 0.0001$. Odds ratio for this comparison was 52 (95% CI, 27 to 96). The estimated annual prevalence of major depression in a job category "professional specialties" was 4.1% (19). Comparing this to the prevalence rate of MDD in USAF pilots and navigators yielded a Chi-square statistic with $P < 0.0001$. Odds ratio for this comparison was 76 (95% CI, 41 to 142). These rates are less than the U.S. general population rate and are greater than the estimated rate of 0.056% for USAF pilots and navigators.

DISCUSSION

The experimental design was reviewed for flaws and confounding factors. The investigators may have failed to find all the cases of MDD in the selected population of USAF pilots and navigators despite due diligence. However, this is theoretically doubtful as every pilot and navigator with MDD must be evaluated and either disqualified or waived to resume flight duty. Following that process the decision must then be recorded in the AIMWTS system. An unknown number of pilots and navigators may have been misdiagnosed. However, diagnoses were rendered by a competent mental health authority after referral by flight surgeons. Further, aeromedical summaries and mental health input were reviewed by senior aeromedical psychiatrists to ensure as much diagnostic accuracy as possible. It is possible that

some depressive episodes were missed. However, flight surgeons are impressed during their training with the importance of "human factors" and of looking for psychological factors affecting aviators. A potential diagnosis of significant depression should prompt referral for competent mental health evaluation. Pressure may be exerted upon the flight surgeon both in garrison and in the deployed setting to "carry" the depressed aviator along and not make the grounding diagnosis of MDD for a variety of erroneous reasons such as not wanting to negatively impact the aviator's flying career or the mission. Flight surgeons are faced with such issues as unit morale vs. mission safety when it comes to evaluating an aviator with a suspected psychiatric disorder (17). However, senior flight surgeons and line commanders are well aware of the negative consequences to flying safety, mission completion, and aviator health of flying while ill.

Aviators may practice "reverse malingering" with psychological or other medical problems. A paper concerning corneal refractive surgery (CRF) noted the myriad ways that aircrew might/may attempt to "cheat" on eye examinations in order to qualify for flight status or remain on flight status in the face of potentially disqualifying vision problems. Pilots with refractive problems memorized the Snellen eye charts and pilots with color vision problems memorized the Ishihara pseudoisochromatic plates. Some even resorted to surgery without informing their flight surgeons in attempts to pass the various vision examinations required of aviators. The term "reverse malingering" was coined to describe denial of medical issues because of excessive motivation to succeed in aviation (10).

Aviators with psychological issues, including MDD, may underreport their symptoms to superiors, peers, flight surgeons, and mental health evaluators. This underreporting is not necessarily volitional and may result from poor symptom recognition because of psychological defense mechanisms such as denial, suppression, and repression. Concern for appearing "weak" in front of their fellow aviators and of possibly damaging their careers is a significant disincentive to report any psychological symptomatology. Pilots and navigators have access to medical standards (AFI 48-123) and are cognizant of potential ramifications, including being grounded, when reporting symptoms of significant depression. The likelihood that there are some pilots and navigators with MDD that have not reported their symptoms is a potentially significant confounding factor. Depressed pilots and navigators may seek psychiatric care outside the military medical treatment system without their flight surgeon's knowledge. This practice could be dangerous and is prohibited by Air Force directives. Realistically, however, it probably does occasionally occur.

Despite potential confounders, it is likely that the mental "make-up" or status of USAF pilots and navigators is significantly different from that of the U.S. general population. Pilot and navigator candidates have an average IQ of 124 (2.5 standard deviations above the mean with a standard deviation of only 3 points) while the average U.S. population has an IQ of 98 (9). Further, pilot

and navigator candidates have successfully overcome physical, behavioral, emotional, and academic hurdles in order to qualify for training. All are college graduates who have passed stringent physical requirements, legal and behavioral background screening, and rigorous operational training programs; i.e., they are a highly screened, selected, and homogenous group. Successful military pilots possessed high self-confidence, sought challenges, and were success-oriented, ambitious, and task oriented. They had exceptional consistency of background and better than average social and socioeconomic conditions while growing up. Further, they were free of intrapsychic conflict, liked to work with teams of similar job-oriented individuals, tended to shy away from emotional introspection, sought advanced educational opportunities, enjoyed aggressive assignments, and were motivated by recognition and approval (2).

Flight surgeons provide further selection screening of the potential aviator during initial contact when they examine emotional and occupational suitability. The Adaptability Rating for Military Aviation is used to evaluate the candidate's suitability for aviation duty (2). Military aviation selection processes have historically recognized the need to eliminate applicants who possessed a tendency toward psychoneuroses (21). Overt anxiety, mood, and personality disorders discovered during the course of initial screening were "show stoppers" (6). Successful aviators were noted to have good skills in leadership, communication, organization and planning, as well as analytical skills, decision-making ability, empathy, emotional maturity, motivation, and energy. The authors of this aviation psychology textbook further suggested that personality assessment was very important in pilot training candidate selection because of these valued traits and skills (11). When attributes brought to the table by aviators are put in perspective, it is highly likely that they are a special population who, because of these attributes, are less prone to psychiatric illness, including MDD, than the general population.

We compared the study population with a population more similar in education and responsibility level than the U.S. general population. One population of executives, administrators, and managers and another of professional specialties yielded estimated annual MDD prevalence of 2.8% and 4.1%, respectively. These rates were significantly greater than the study population of active duty USAF pilots and navigators, whose estimated annual prevalence was 0.056%. Of the 51 diagnosed and treated cases of MDD discovered over a 5-yr period, only 18 returned to flying. MDD manifested by recurrent episodes was not waived and none of the eight aviators in this category returned to USAF flying. Of the remaining 43 aviators, 18 with single episode MDD received waivers. Our data and methods did not address why the remaining 25 did not receive waivers.

The Canadian Forces allow selected pilots with MDD in remission to fly with restrictions while taking maintenance selective serotonin reuptake inhibitors (SSRIs) (15). The Australians allow selected pilots to fly with MDD in remission while taking maintenance SSRIs and

their safety record has been excellent since the policy was adopted (20). The U.S. Federal Aviation Administration (FAA) is considering under what circumstances FAA Third Class pilots might fly while taking antidepressant medication (17) and the Aerospace Medical Association has published a position paper addressing this complex subject (7).

It is conceivable that, if carefully monitored by flight surgeons and aviation mental health professionals, some USAF pilots and navigators with remitted MDD, totally stable and asymptomatic on SSRI therapy, might be allowed to fly under certain conditions (such as "with or as co-pilot"), at least in garrison. If such a policy were adopted by the USAF, use of a centralized evaluation and management group facility such as the USAFSAM Aeromedical Consultation Service would be appropriate to oversee specialized group requirements and recommendations.

This study's goal was to determine the reported prevalence of active duty USAF pilots and navigators experiencing MDD. That number was very small: 10/17,781 or 0.056% of the average pilot and navigator population per year. The number not receiving a waiver to return to flying status was: 7/17,781 or 0.038% per year. Aeromedical policy makers should consider this information when deciding under what circumstances to consider waiver policy changes regarding extended use of SSRI-type medication and medical/psychiatric follow up in pilots and navigators. Risks of medication use and disease recurrence should be weighed against replacement training costs and loss of experience/talent. The number of pilots/navigators that would receive a waiver because of this policy change is unknown. Study of MDD prevalence in non-pilot/navigator aircrew assets should be studied as well to clarify potential impact of waiver policy change for other career fields.

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REFERENCES

1. American Psychiatric Association. Diagnostic and statistical manual of mental disorders, 4th ed. Washington, DC: American Psychiatric Association; 2000:1-994.
2. Davis JR, Johnson R, Stepanak J, Fogarty JA. Fundamentals of aerospace medicine, 4th ed. Baltimore: Lippincott, Williams, and Wilkins; 2008:406-24.
3. Dew RE, Kramer SI, McCall WV. Adequacy of antidepressant treatment by psychiatry residents: the antidepressant treatment history form as a possible assessment tool. *Acad Psychiatry* 2005; 29:283-8.
4. Greenberg PE, Kessler RC, Birnbaum HG, Leong SA, Lowe SW, et al. The economic burden of depression in the United States: how did it change between 1990 and 2000? *J Clin Psychiatry* 2003; 64:1465-75.
5. Healthy People 2010. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion 2005; Rockville, Maryland. Retrieved 15 July 2007 from the DHHS at http://www.healthypeople.gov/LHI/Touch_fact.htm.
6. Jensen RS. Aviation psychology. Aldershot: Gower Technical Press; 1989:1-259.
7. Jones DR, Ireland RR. Aeromedical regulation of aviators using selective serotonin reuptake inhibitors for depressive disorders. *Aviat Space Environ Med* 2004; 75:461-70.
8. Kaplan VA, Sadock BJ. Synopsis of psychiatry, 10th ed. Philadelphia, PA: Lippincott, Williams, and Wilkins; 2007:1-400.
9. Lynn R, Vanhanen T. Intelligence and the wealth and poverty of nations. Augusta, GA: Washington Summit Publishers; 2003:1-10.
10. Markovits AS. Photo-refractive keratectomy (PRK): threat of millenium for military pilots? *Aviat Space Environ Med* 1993; 64:409-11.
11. McDonald N, Johnston N, Fuller R. Applications of Psychology to the Aviation System—Proceedings of the 21st Conference of the European Association for Aviation Psychology. Aldershot, England: Avebury Publishing Company; 1995:1-300.
12. National Institute of Mental Health. The numbers count. National Institute of Health; 2008:1-5. Retrieved 18 June 2008 from <http://www.nimh.nih.gov/health/publications/the-numbers-count-mental-disorders-in-america/>.
13. Palpant RG, Steimitz R, Bornermann TH, Hawkins K. The Carter Mental Health Program: addressing the public crisis in the field of mental health through policy change and stigma reduction. *Prevention of Chronic Disease* (serial online); 2006:1-10. Retrieved on 15 July 2007 from http://www.cdc.gov/ped/issues/apr/05_0175.htm.
14. Patterson JC, Jones DR, Marsh RW, Drummond FE. Aeromedical management of U.S. Air Force aviators who attempt suicide. *Aviat Space Environ Med* 2001; 72:1081-5.
15. Paul MA, Gray GW, Love RJ, Lange M. SSRI effects on psychomotor performance: assessment of citalopram and escitalopram on normal subjects. *Aviat Space Environ Med* 2007; 78:693-7.
16. Portney LG, Watkins MP. Foundations of clinical research: applications to practice, 2nd ed. NJ: Prentice Hall Health; 2000:1-742.
17. Rayman RB, Hastings JD, Kruey WB, Levy RA, Pickard JS. Clinical aviation medicine, 4th ed. New York: Professional Publishing Group, Ltd; 2006:289-310.
18. Remick RA. Diagnosis and management of depression in primary care: a clinical update and review. *CMAJ* 2002; 167:1253-60.
19. Roberts RE, Lee ES. Occupation and the prevalence of major depression, alcohol, and drug abuse in the United States. *Environ Res* 1993; 61:266-78.
20. Ross J, Griffiths K, Dear K, Emonson D, Lambeth L. Antidepressant use and safety in civil aviation: a case-control study of 10 years of Australian data. *Aviat Space Environ Med* 2007; 78:749-55.
21. Solomon HC, Yakolev PI. Manual of military neuropsychiatry. Philadelphia: W.B. Saunders Company; 1944:1-764.
22. United States Air Force. Air Force Instruction 48-123, attachment 4: medical standards for flying duty, specifically A4.25.1.8.1. Washington, DC: Department of the Air Force; 2006. Retrieved online at: https://kx.afms.mil/kxweb/dotmil/file/web/ctb_054996.pdf.